

## TYPHOON FREDA (13W)

Freda was the first of seven significant tropical cyclones to develop during the month of September and the middle tropical cyclone (geographically) of three systems that developed at nearly the same time; namely Freda, Typhoon Gerald (14W) and Super Typhoon Holly (15W). During this three tropical cyclone outbreak, individual development and movement trends were very similar even though the systems were never closer together than 900 nm (1667 km). Freda was unusual because although it traversed less than 10 degrees of longitude while in warning status, it moved northward for almost twenty-five degrees of latitude. Freda's thirteen day life span and fifty warnings were WESTPAC records for 1987.



With the tropical disturbance just southeast of Guam, there was heightened concern about intensification as the system moved into an area of decreased vertical shear. During the night, infrared satellite images showed a flaring of convection, rapidly expanding cirrus outflow and a speedy displacement of the cloud system toward the west. Satellite analysis at 041745Z estimated maximum sustained surface winds of 30 kt (15 m/sec) and supported the issuance of the first warning on Tropical Depression 13W at 041800Z. (This was also the time JTWC went to warning on Tropical Depression 14W.) Within six hours, after the first visual satellite imagery provided a better look, Tropical Depression 13W was relocated 215 nm (398 km) east-southeast of the earlier expected position.

Freda developed in *Figure 3-13-1. First appearance of Freda's eye* an active monsoon trough. (061723Z September 1987 (OAA infrared imagery).

The disturbance first appeared as a persistent cluster of convection in the eastern Caroline Islands on the 1st of September. Due to the persistent convective activity it was mentioned as a new suspect area on the 030600Z Significant Tropical Weather Advisory (ABPW PGTW). A low-level cyclonic circulation was apparent in the synoptic surface/gradient-level data beginning at 031200Z. By 040000Z, synoptic data indicated winds of 20 to 30 kt (10 to 15 m/sec). Satellite intensity analysis (Dvorak, 1984) estimated maximum sustained surface winds of 25 kt (13 m/sec). These data, plus a distinct gradient-level circulation and a 3 mb pressure fall over the past 24-hours (to a minimum of 1003 mb) supported a Tropical Cyclone Formation Alert issued at 040357Z.

Warning number two included the amplifying remarks:

*Satellite imagery over the past six hours for Tropical Depression 13W indicate that the feature previously tracked on infrared imagery, has weakened, hence the system has been relocated. The latest visual imagery shows low-level cloud lines placing the low-level circulation center substantially further to the east than previously expected. This also indicates a slower forward speed.*

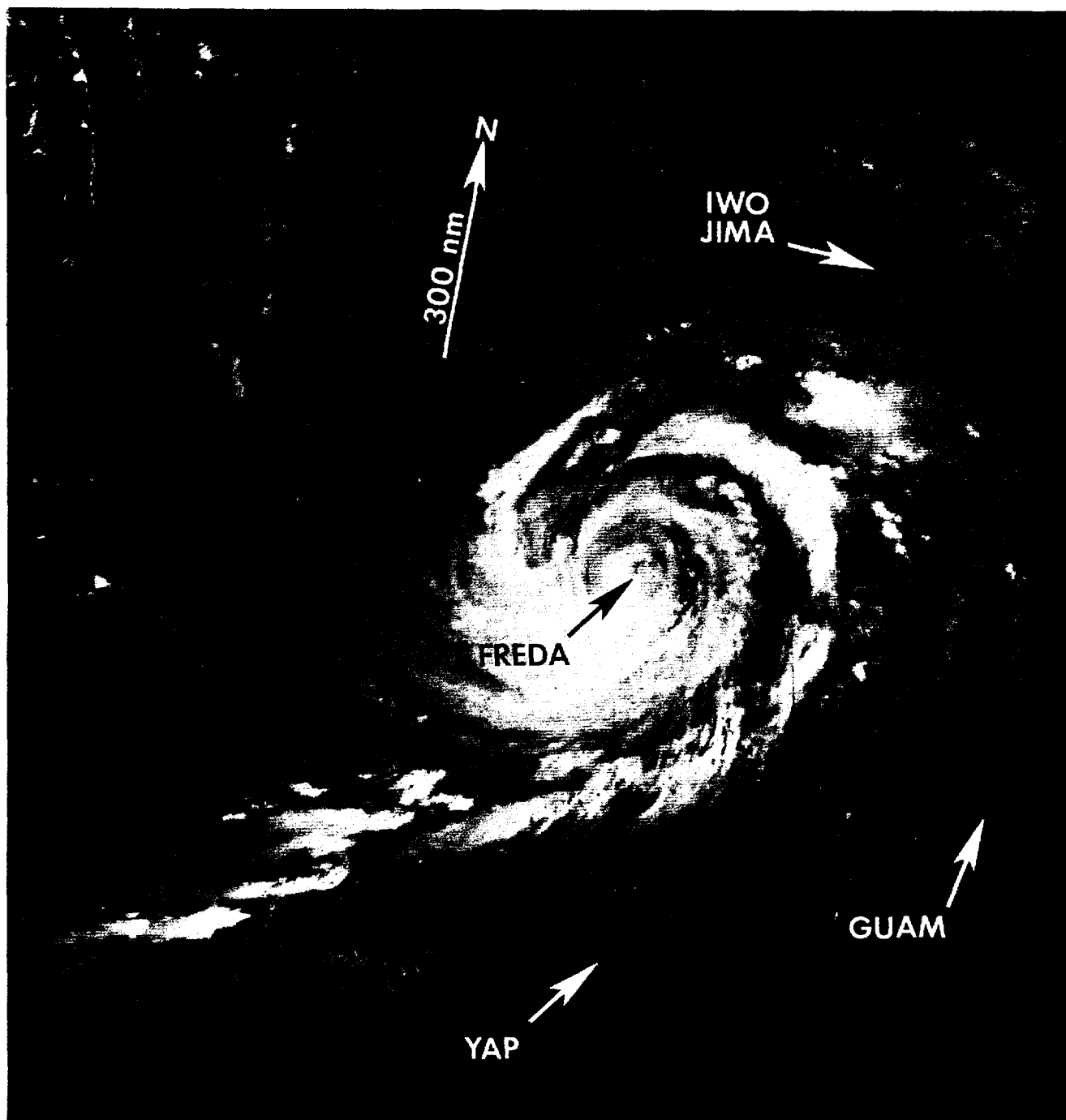


Figure 3-13-2. Typhoon Freda near maximum intensity. Note the elongation of the cloud system from east-northeast to west-southwest (110030Z September DMSP visual imagery).

Freda passed approximately 30 nm (56 km) southwest of Guam while moving north-westward at 14 kt (26 km/hr) with an estimated intensity of 25 to 30 kt (13 to 15 m/sec). Once past Guam, Freda developed rapidly and was upgraded to tropical storm intensity at 050600Z. (It was at this time that JTWC also began

warning on Tropical Depression 15W, thus creating the second three-storm warning situation of the year.)

Suddenly, twelve-hours later, Freda appeared to become quasi-stationary at a position approximately 250 nm (463 km) to the

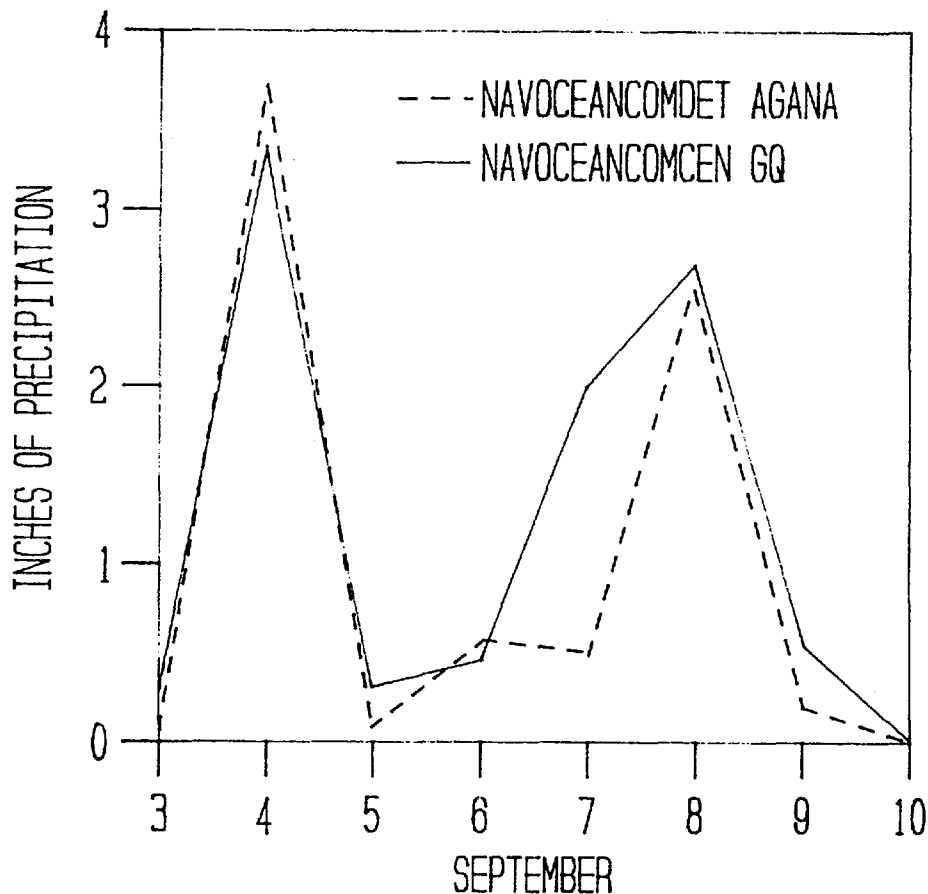


Figure 3-13-3. Plot of the daily amounts of precipitation at two recording stations on Guam as spiral convective arms from Freda passed over the island.

west-northwest of Guam. This was also the same time that Tropical Storm Gerald (14W) became quasi-stationary. The two systems were approximately 900 nm (1667 km) apart at that time.

With the appearance of a small ragged eye on satellite imagery at 061723Z (see Figure 3-13-1), Freda was upgraded to typhoon intensity. After executing a tight cyclonic loop, Freda began to move slowly westward on the 8th. Then, on the 10th, Freda slowed and started a tight turn toward the northeast. Concurrently with the track change, Freda reached an estimated peak intensity of 125 kt (64 m/sec), based on Dvorak satellite intensity analysis. Figure 3-13-2 shows Freda early on

the 11th as it rounds the western periphery of the subtropical ridge. Note the elongation of the cloud system into an east-northeast/west-southwest orientation. This asymmetry is a consequence of adjustments between the tropical cyclone and the ambient flow. (One day prior to Freda's change in track toward the north, Super Typhoon Holly (15W) also moved northward. At 091200Z, the two systems were approximately 1080 nm (2000 km) apart. Super Typhoon Holly (15W) had been steadily moving closer to Freda from the east prior to the northward bends in their tracks.)

During this prolonged northward trek, a consequence of the intense monsoonal trough and the absence of a strong subtropical ridge,

Freda started to slowly accelerate and weaken. At 1800Z on the 13th, Freda was downgraded to tropical storm intensity.

On the 16th, Freda began to interact with an eastward-moving, mid-level trough passing to the north of the system. This interaction resulted in a curved track toward the northeast. As a result, Freda missed the southeastern tip of Honshu by approximately

180 nm (333 km). Shortly thereafter, Freda began extratropical transition as vertical wind shear increased and the system entrained dry, cool, mid-latitude air. The last warning was issued by JTWC at 170000Z as the system accelerated toward the northeast.

Guam received two distinct heavy periods of rain over five days when Freda stalled to the west (Figure 3-13-3). Specifically

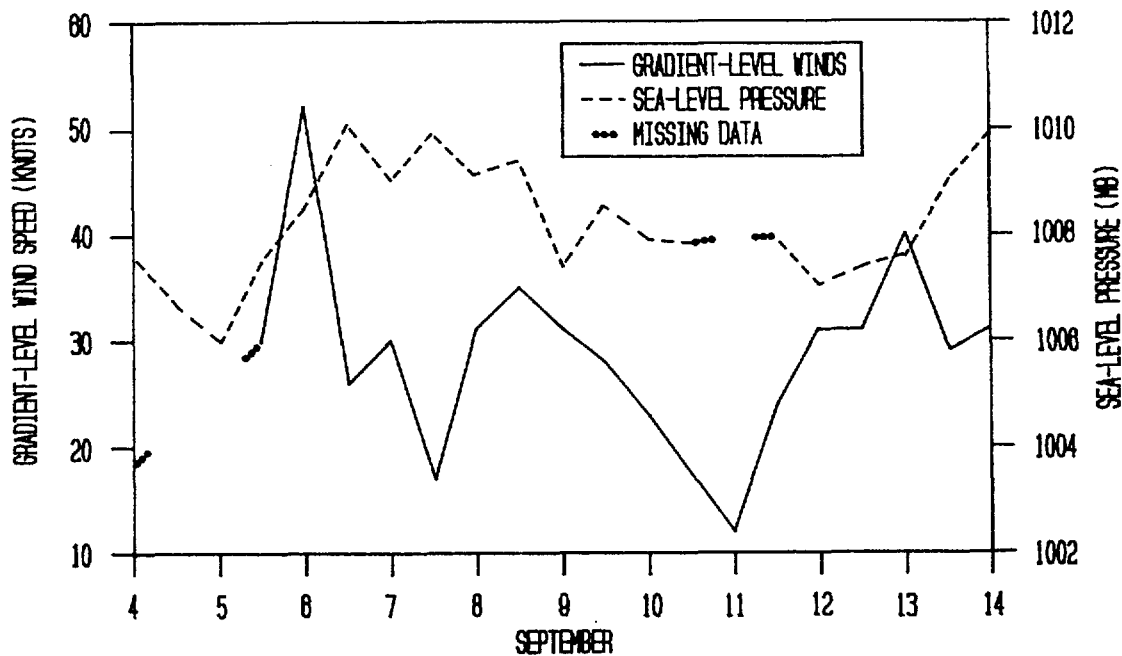


Figure 3-13-4. Gradient-level wind speeds and sea-level pressure on Guam as Freda stalled southwest of the island. The period of lighter winds from the 10th through the 11th was associated with the proximity of the zone of low-level speed convergence (convergent asymptote) between Freda and Super Typhoon Holly (15W).

on the 4th of September, when Freda was close by NAVOCEANCOMCEN/JTWC located on Nimitz Hill, Guam received 3.35 in (8.51 cm) of precipitation, and the Naval Oceanography Command Detachment at the Naval Air Station Agana, a few miles further north, received 3.75 in (10.93 cm). On the 8th, over 2.5 in (6.35 cm) of rain fell on Guam as convection associated with a spiral band passed overhead. Due to the proximity of Freda, and later Super Typhoon Holly (15W), Guam experienced periods of

gales from the south-southwest to west-southwest for nearly 10 days (from the 5th through the 14th) (Figure 3-13-4). The strongest observed winds reported during this period were the 40 kt (21 m/sec) southwesterly gradient-level winds at 121200Z. The resulting high seas and hazardous surf through the Marianas disrupted shipping, destroyed seawalls, damaged reefs, eroded beaches and stranded islanders; but fortunately no lives were lost.